

CLAIMS

1. A haloaluminoxane composition wherein the halogen is fluorine, chlorine, and/or bromine, and wherein the amount of halogen atoms present in said composition is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms.

2. A composition according to Claim 1 wherein said composition is formed from components comprising

- (a) at least one aluminoxane and
- (b) at least one halogenation agent which is

(i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty carbon atoms;

or

(ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms,

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v).

3. A composition according to Claim 1 wherein the amount of halogen atoms present in said composition is in the range of about 2 mole % to about 10 mole % relative to aluminum atoms.

4. A composition according to Claim 1 wherein the halogen is fluorine.
5. A composition according to Claim 2 wherein (b) is at least one halohydrocarbon.
6. A composition according to Claim 2 wherein said haloaluminoxane composition is a partially halogenated aluminoxane.
7. A composition according to Claim 6 wherein (b) is at least one siloxane, silane, tin compound, or hydrocarbyl aluminum halide.
8. A composition according to Claim 2 wherein the hydrocarbyl groups of said aluminoxane are saturated, and have from one to about twenty carbon atoms.
9. A composition according to Claim 2 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.
10. A composition according to Claim 5 wherein said halohydrocarbon is one in which at least one R is an aryl group.
11. A composition according to Claim 10 wherein said halohydrocarbon is α,α,α -trifluorotoluene.
12. A composition according to Claim 5 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said halohydrocarbon is one in which at least one R is an aryl group.
13. A composition according to Claim 5 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said halohydrocarbon is α,α,α -trifluorotoluene.
14. A composition according to Claim 13 wherein said haloaluminoxane is an ionic haloaluminoxane complex.

15. A composition according to Claim 13 wherein said haloaluminoxane is a partially halogenated aluminoxane.

16. A composition according to Claim 7 wherein said halogenation agent is a silane.

17. A composition according to Claim 7 wherein said halogenation agent is a silane, and wherein said silane is triphenylfluorosilane or trimethylfluorosilane.

18. A composition which comprises a haloaluminoxane composition as in Claim 2 supported on a catalyst support or carrier.

19. A composition as in Claim 18 wherein said inorganic support or carrier is silica, alumina, or silica-alumina.

20. A composition according to Claim 18 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.

21. A composition according to Claim 18 wherein (b) is at least one halohydrocarbon, and wherein said halohydrocarbon is one in which at least one R is an aryl group.

22. A composition according to Claim 18 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, wherein (b) is at least one halohydrocarbon, and wherein said halohydrocarbon is one in which at least one R is an aryl group.

23. A composition according to Claim 22 wherein said halohydrocarbon is α,α,α -trifluorotoluene, and wherein said catalyst support or carrier is silica.

24. A composition according to Claim 7 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane; wherein said halogenation agent is a siloxane; and wherein said siloxane is a trisiloxane or a tricyclosiloxane.

25. A composition according to Claim 7 wherein said halogenation agent is a siloxane, and wherein said siloxane is 3,3,3-trifluoropropylheptamethyltrisiloxane, 3,3,3-trifluoropropylheptamethylcyclotrisiloxane, or poly[methyl(3,3,3-trifluoropropyl)siloxane].

26. A composition according to Claim 25 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.

27. A composition according to Claim 18 wherein said haloaluminoxane composition is a partially halogenated aluminoxane.

28. A composition according to Claim 27 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said inorganic support or carrier is silica, alumina, or silica-alumina.

29. A composition according to Claim 27 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane; wherein said halogenation agent is a siloxane; and wherein said siloxane is a trisiloxane or a tricyclosiloxane.

30. A composition according to Claim 27 wherein said halogenation agent is a siloxane, and wherein said siloxane is 3,3,3-trifluoropropylheptamethyltrisiloxane, 3,3,3-trifluoropropylheptamethylcyclotrisiloxane, or poly[methyl(3,3,3-trifluoropropyl)siloxane].

31. A composition according to Claim 30 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.

32. A composition according to Claim 27 wherein said aluminoxane is methylaluminoxane; wherein said halogenation agent is a siloxane, wherein said siloxane is poly[methyl(3,3,3-trifluoropropyl)siloxane], and wherein said support is silica.

33. A process which comprises mixing, in an inert, anhydrous environment,

- (a) at least one aluminoxane and
- (b) at least one halogenation agent which is
 - (i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty

carbon atoms;

or

(ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v);

wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms, such that a haloaluminoxane composition is formed.

34. A process according to Claim 33 wherein (b) is at least one halohydrocarbon.

35. A process according to Claim 33 wherein said haloaluminoxane composition is a partially halogenated aluminoxane.

36. A process according to Claim 35 wherein (b) is at least one siloxane, silane, tin compound, or hydrocarbyl aluminum halide.

37. A process according to Claim 33 wherein said inert, anhydrous environment is an anhydrous liquid hydrocarbon solvent.

38. A process according to Claim 37 wherein said anhydrous liquid hydrocarbon solvent is an aromatic hydrocarbon.

39. A process according to Claim 38 wherein said aromatic hydrocarbon is toluene.
40. A process according to Claim 33 wherein the hydrocarbyl groups of said aluminoxane are saturated, and have from one to about twenty carbon atoms.
41. A process according to Claim 33 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.
42. A process according to Claim 34 wherein said halohydrocarbon is one in which at least one R is an aryl group.
43. A process according to Claim 34 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said halohydrocarbon is one in which at least one R is an aryl group.
44. A composition according to Claim 34 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said halohydrocarbon is α,α,α -trifluorotoluene.
45. A process according to Claim 34 wherein said aluminoxane is methylaluminoxane; wherein said halohydrocarbon is α,α,α -trifluorotoluene; and wherein said inert, anhydrous environment is toluene.
46. A process according to Claim 45 wherein said haloaluminoxane is an ionic haloaluminoxane complex.
47. A process according to Claim 45 wherein said haloaluminoxane is a partially halogenated aluminoxane.
48. A process according to Claim 36 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane; wherein said halogenation agent is a siloxane; and wherein siloxane is a trisiloxane or a tricyclosiloxane.

49. A process according to Claim 36 wherein said halogenation agent is a siloxane, and wherein said siloxane is 3,3,3-trifluoropropylheptamethyltrisiloxane, 3,3,3-trifluoropropylheptamethylcyclotrisiloxane, or poly[methyl(3,3,3-trifluoropropyl)siloxane].

50. A process according to Claim 49 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.

51. A process according to Claim 36 wherein said aluminoxane is methylaluminoxane; wherein said halogenation agent is a siloxane, wherein said siloxane is poly[methyl(3,3,3-trifluoropropyl)siloxane]; and wherein said inert, anhydrous environment is toluene.

52. A process according to Claim 36 wherein said halogenation agent is a silane.

53. A process according to Claim 36 wherein said halogenation agent is a silane, and wherein said silane is triphenylfluorosilane or trimethylfluorosilane.

54. A process according to Claim 33 further comprising forming a supported haloaluminoxane by

- A) contacting said haloaluminoxane composition with a support material, or
- B) contacting a support material with (a) and (b)
such that a supported haloaluminoxane is formed.

55. A composition formed from interaction between components comprising (I) either a haloaluminoxane wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms, or

- (a) at least one aluminoxane and
- (b) at least one halogenation agent which is
 - (i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty carbon atoms;

or

- (ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v),

wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms;

and

(II) at least one catalyst compound or complex of a transition metal of Groups 3 to 11 including the lanthanide series and the actinide series.

56. A process for forming a catalyst composition which comprises interacting, in an inert aromatic solvent, components comprising

(I) either a haloaluminoxane wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms, or

(a) at least one aluminoxane and

(b) at least one halogenation agent which is

(i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty carbon atoms;

or

(ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v),

wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms;

and

(II) at least one catalyst compound or complex of a transition metal of Groups 3 to 11 including the lanthanide series and the actinide series.

57. A process according to Claim 56 further comprising forming a supported catalyst composition by

- A) contacting a support material with (I) and (II), or
- B) contacting (I) with a support material, or
- C) contacting (II) with a support material, or
- D) contacting said catalyst composition with a support material, such that a supported catalyst composition is formed.

58. A process of producing a polyolefin polymer, which process comprises polymerizing at least one polymerizable olefinic monomer in the presence of a catalyst composition comprised of a composition of Claim 55.